Case Report

Radioguided Parathyroidectomy via VATS Combined With Intraoperative Parathyroid Hormone Testing: The Surgical Approach of Choice for Patients With Mediastinal Parathyroid Adenomas?

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ABSTRACT

Despite the excellent results with bilateral exploration, minimally invasive parathyroidectomy has become the procedure of choice for patients with hyperparathyroidism in which a single parathyroid lesion can be localized preoperatively. In this article, we discuss a patient who presented with primary hyperparathyroidism for the first time and had a Tc-99m sestamibi scan to localize a single parathyroid lesion in the left, anterior mid-mediastinum. We subsequently performed a radioguided parathyroidectomy via video-assisted thoracoscopic surgery (VATS) to resect this parathyroid adenoma and used intraoperative parathyroid hormone (PTH) testing to confirm cure and avoid neck exploration. We concluded that radioguided parathyroidectomy via VATS combined with intraoperative PTH testing is an effective approach for patients with primary hyperparathyroidism and mediastinal parathyroid lesions, and perhaps should be the technique of choice. (J Bone Miner Res 2002;17:1368–1371)

Key words: minimally invasive parathyroidectomy, video-assisted thoracoscopic surgery, radioguided, mediastinal adenoma, intraoperative parathyroid hormone

INTRODUCTION

P ARATHYROIDECTOMY IS the only curative treatment for primary hyperparathyroidism. Bilateral neck exploration with resection of enlarged parathyroid gland(s) is associated with a >95% cure rate and minimal morbidity in the hands of an experienced endocrine surgeon.[1,2] Despite the excellent results with bilateral exploration, "minimally invasive parathyroidectomy" has become the procedure of choice for patients with hyperparathyroidism in which a single parathyroid lesion can be localized preoperatively.[3]

Our technique for minimally invasive parathyroidectomy consists of preoperative localization with Tc-99m sestamibi-single photon emission computed tomography (SPECT) scanning, intraoperative localization with a gamma probe, local anesthesia, and confirmation of cure after resection of the single parathyroid lesion with intraoperative parathyroid hormone (PTH) testing. Thus, we routinely obtain a preoperative localization scan on all patients with primary hyperparathyroidism to determine if they are candidates for this approach.
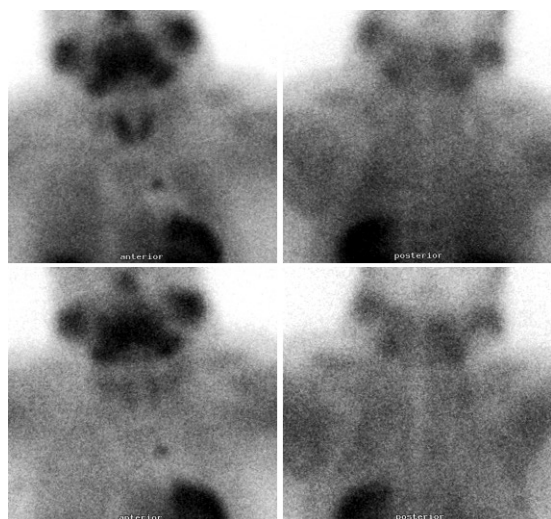
FIG. 1. Tc-99m sestamibi-SPECT scan showing a mediastinal parathyroid adenoma. Top, (left) early images with anterior view and (right) posterior view; bottom, delayed images.

In this article, we report on a patient who presented with primary hyperparathyroidism for the first time and had a Tc-99m sestamibi scan localizing a single lesion retrosternally in the left anterior mediastinum, below the level of the suprasternal notch. We subsequently performed a radioguided parathyroidectomy via video-assisted thoracoscopic surgery (VATS) to resect this parathyroid adenoma and used intraoperative PTH testing to confirm cure and avoid neck exploration. To our knowledge, this represents the first case report of a patient with a single, mediastinal parathyroid adenoma cured with radioguided parathyroidectomy via VATS without a neck exploration.

CASE REPORT

The patient was a 43-year-old woman with a history of recurrent calcium oxylate renal stones. Her past medical history was significant for gastroesophageal reflux disease, hiatal hernia, nephrolithiasis, and mild mental retardation. Her surgical history was significant for bilateral breast reduction, cesarean section, percutaneous nephrostomy tube, and lithotripsy for her renal calculi. During investigation of her recurrent renal calculi, her calcium was found to be elevated to 11.9 mg/dl (normal range, 8.5–10.2 mg/dl), and her parathyroid hormone level was elevated to 304 pg/ml (normal range, 15–65 pg/ml). Her alkaline phosphatase was 132 mg/dl, and 24-h urinary calcium was 319 mg. Bone densitometry studies were significant for decreased lumbar and femoral neck scores. A planar Tc-99m sestamibi localization scan was performed, which demonstrated increased uptake in the mediastinum consistent with amediastinal parathyroid adenoma (Fig. 1). A subsequent repeat study using a combined nuclear medicine SPECT and computed tomography (CT) scanner (GE VG/Hawkeye; General Electric, Waukesha, WI, USA) was performed to localize the

adenoma relative to other chest structures (Fig. 2). This revealed a mass in the left anterior mediastinum, consistent with a parathyroid adenoma.

The patient was taken to the operating room after injection with 10 mCi Tc-99m sestamibi for intraoperative localization. A thoracoscopic exploration using three ports (11, 11, and 5 mm) was performed after establishing one-lung ventilation with a double-lumen endotracheal tube. A gamma probe (NeoProbe; Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA), was used to assist the exploration and localize increased counts to the preaortic area anterior to the left phrenic nerve. The mediastinal pleura was excised at this location, and the mediastinal fat pad incised anteromedial to the ascending aorta using a harmonic scalpel. Once incised, the fat pad was explored, and the adenoma identified and resected. The gamma probe was used to confirm that the resected specimen had very elevated counts consistent with parathyroid tissue. This was sent to pathology and confirmed to be a 425-mg hypercellular parathyroid. No further elevations in gamma counts were noted on inspection of the mediastinum with the NeoProbe. The patient's PTH level at the time of incision was 195 pg/ml. The level decreased to 25 and 21 pg/ml when measured at 5 and 10 minutes, respectively, after excision of the adenoma, confirming that no other hyperfunctioning parathyroid glands were present. Because the intraoperative PTH levels confirmed surgical cure, the operation was terminated and a chest tube was placed through one of the 11-mm port sites. The chest tube was removed the following morning, and the patient was discharged home on postoperative day 1, less than 24 h after surgery. In follow-up, the patient's serum calcium levels normalized and have remained stable at 9.1–9.4 mg/dl at 1 month after surgery. Her intact PTH levels have remained less than 55 pg/ml. Within 1 week, the patient was functioning at full capacity, which included participating in her weekly bowling league.

DISCUSSION

Minimally invasive parathyroidectomy may be the procedure of choice for primary hyperparathyroidism. Approximately 70% of patients with primary hyperparathyroidism can be localized with preoperative imaging and are therefore candidates for the minimally invasive approach.[3] This has led to an increase in the use of preoperative parathyroid imaging. Before the development of minimally invasive parathyroidectomy, most surgeons proceeded directly to bilateral neck exploration for patients with the biochemical diagnosis of primary hyperparathyroidism, without performing preoperative localization scans. In experienced hands, bilateral exploration is associated with a >95% cure rate and minimal morbidity.[1,2] However, up to one-half of the failures in these cases are caused by mediastinal parathyroid adenomas.[4] With the increasing use of preoperative parathyroid imaging, many of these mediastinal adenomas can now be detected before neck exploration. Therefore, what should be the approach in a patient with primary hyperparathyroidism who has a localizing scan to
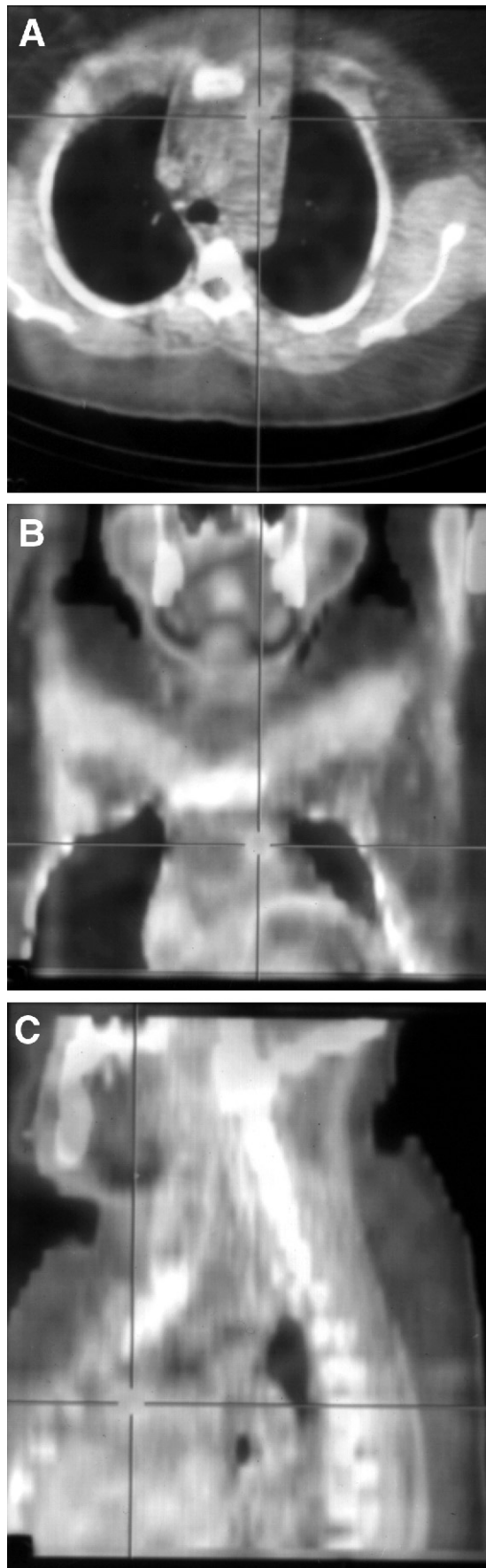
the mediastinum and has not had a previous neck exploration to assess the parathyroid glands in the neck?

We provide the following algorithm. After mediastinal localization by Tc-99m sestamibi-SPECT, either a chest CT or magnetic resonance imaging (MRI) should be used to anatomically confirm the location of a mass. If the nuclear medicine department has a combined SPECT/CT device, the initial imaging procedure can provide this functional-anatomical imaging procedure and can be performed to confirm the presence of mediastinal localization and provide anatomic information simultaneously. If the parathyroid gland is in the superior mediastinum, a cervical approach with possible sternotomy could be considered. However, in most cases VATS would be preferred. On the day of surgery, 2 h before incision, the patient is injected with 10 mCi Tc-99m sestamibi (one-half the usual imaging dose). After intraoperative localization with the gamma probe and resection via VATS, peripheral blood should be sampled for intraoperative PTH testing at 5 and 10 minutes after gland resection. If the PTH level falls by >50%, the operation is terminated. If the PTH level remains elevated, the neck is explored and all parathyroid glands identified.

We believe that radioguided parathyroidectomy via VATS, combined with intraoperative PTH assay, is the ideal approach for these patients as illustrated in this case report. The three key components of this approach after mediastinal identification of a possible adenoma are as follows: 1) the gamma probe, 2) VATS, and 3) the intraoperative PTH assay.

First, more and more surgeons are employing the gamma probe to guide parathyroid exploration in the neck. We have shown that the use of the gamma probe facilitates identification of the parathyroid gland, allows omission of frozen section confirmation, and reduces operative time during neck exploration (H. Chen, unpublished observations, 2001). In the current case, the gamma probe allowed localization of the mediastinal parathyroid that could not be visualized by the video camera within the left thymus. The gamma probe aided in locating and dissecting the parathyroid adenoma. In our patient, there was a considerable amount of mediastinal fat that made visualization by the video camera even more difficult. Ott et al.[5] have also described the benefit of radioguided, intraoperative gamma probe localization. Recently, they published the first report of radioguided parathyroidectomy via VATS in a single patient with persistent hyperparathyroidism after a failed neck exploration.[5] However, in contrast, our patient did not require a neck exploration.

Second, in this patient, the parathyroid adenoma was in the low-lying superior mediastinum and not accessible from the neck. Thus, the two surgical options were sternotomy or VATS. Sternotomy for resection of parathyroid adenomas is associated with a morbidity rate of 20%, including pulmo-

FIG. 2. Tc-99m sestamibi-computed tomography scan localizing the parathyroid adenoma to the thymus with the anterior-mid mediastinum. The intersecting lines mark the parathyroid gland. (A) Cross-section, (B) coronal section, and (C) sagittal section.

nary complications, wound/sternal infections, deep venous thrombosis, and arrhythmias.[4,6] In the largest report of VATS resection for parathyroid lesions, Medrano et al.[7] reported 7 patients with persistent hyperparathyroidism after failed neck exploration. In their hands, all patients were cured of their hypercalcemia with VATS, and only 1 patient had a complication (transient neuralgia lasting 2 weeks). Other investigators have reported similar successes with VATS for parathyroid resection.[8,9] Notably, all previously reported VATS resections have been in patients who had previous neck explorations.

Third, the intraoperative PTH assay is a crucial component of any minimally invasive parathyroidectomy approach. It is mainly used to determine if there are additional hyperfunctioning parathyroid gland(s). In our patient, the fall of $>50\%$ of the PTH level after resection of the mediastinal parathyroid indicated that no other hyperfunctioning parathyroid glands were present. However, if the PTH level had not fallen, we were prepared to explore the patient's neck to find and resect other hyperfunctioning parathyroid glands.

In conclusion, radioguided parathyroidectomy via VATS combined with intraoperative PTH testing is an effective approach for patients with primary hyperparathyroidism and mediastinal parathyroid lesion and perhaps should be the technique of choice.

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